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Classics in physical geography revisited

Grove, J.M. 1988: *The Little Ice Age.* London: Routledge, xxii + 498 pp.

Jean Grove was a consummate detective of ancient climate change, like the late Hubert Lamb of the University of East Anglia, a pioneer of climatological detective work. Whereas Lamb looked at climate change on a broader chronological canvas, Grove focused her efforts on the Little Ice Age, the six centuries of unpredictable, often frigid conditions between the thirteenth and nineteenth centuries AD that had a considerable, if inconspicuous, effect on history. *The Little Ice Age* appeared in 1988, a lifetime ago in paleoclimatological terms, given the staggering advances of recent years. Grove had few ice cores and many fewer tree-ring sequences to work with. Furthermore, as she rightly complained, historians had long tended to discount the importance of short-term climatic change on human affairs, despite the substantive researches of both Lamb and the French scholar Le Roy Ladurie. The latter's investigations of the timing of French wine harvests ushered in a new, if unheralded, era in climatic detective work. Faced with a dearth of information, Grove decided to set the Little Ice Age in the context of the longer timeframe of the Holocene, then see how such a perspective would enhance our understanding of human affairs.

Figure 1 Jean Grove (Photo courtesy of the Mistress and Fellows, Girton College, Cambridge)

The term 'Little Ice Age' entered scientific literature in 1939, at first seen as a period of renewed glaciation, then, by the time Grove wrote her book, known for its unsettled, constantly changing climate. She began her study with glaciers and sea ice in Iceland, for climatic conditions around that island have an important bearing on northwest European climate. Here, she relied heavily on incomplete medieval historical records for a chronicle of deteriorating climate and spreading sea ice after the twelfth century, a time when cereal farming ceased. From Iceland, she moved to Scandinavia, where she chronicled the enlarged glaciers and ice sheets of the eighteenth century. In both Iceland and Scandinavia, glacial history was very complex. Both advances and contractions depended on both heavy winter precipitation and the levels of summer temperatures.

The Alps are the homeland of Ice Age research and offer exceptional potential for Little Ice Age investigations. Grove covered the Alps in three chapters. She started with

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the Mont Blanc massif, where she documented the importance of low summer temperatures and heavy summer snowfall to glacier expansion. Plentiful historical records showed that Mont Blanc glaciers expanded during periods of lower temperatures over recent centuries, but the record was much sparser for earlier centuries, the history of Alpine passes being virtually unknown. Here, as elsewhere, Grove relied on obscure historical proxies. For example, applications for tax relief by villages near expanding glaciers offer some of the most useful historical sources for chronicling glacial advances that covered fields. From Mont Blanc, she shifted to the Ötztal of the eastern Alps, where the fluctuations of glacial advance and retreat coincide with those in the west. As Grove pointed out, many Swiss towns and villages are threatened by avalanche and flooding, with the result that historical records of glacial events tend to be more complete than usual. Grove gives us an admirable summary of glacial expansion from various glaciers, including the Allalin, which was much enlarged during the thirteenth century. Modern retreats of the nearby Aletsch glacier have uncovered larch and other trees still in their original growth spots. These were about 150 years old before being overwhelmed and have been radiocarbon dated to about 1150 to 1200. Grove concluded that the Little Ice Age in Switzerland was a period of cold winters extending into March, with wet summers and a long growing season, with minor climatic fluctuations lasting decades and ending in about 1860. After that, 'the climbing huts of the Victorians look down on glaciers from which a little of the glory has departed' (p. 198).

Both Grove and Hubert Lamb were among the first to document the worldwide impact of the Little Ice Age. At the time she wrote her book, climatic evidence was virtually non-existent outside Europe and North America. It is only in recent years that climatological research has gained impetus on a global canvas, thanks in large part to the controversies over global warming and El Niños. Grove summarized what little was known from areas outside at the time. She covered the limited glacial evidence from Asia, the Urals, the Caucasus, and the Pamir, as well as mountain ranges further east, and from the Himalayas, where she drew attention to numerous explorers' accounts of mountain glaciation. In China, she summarized evidence for glacier shrinkage and expansion and described some limited tree-ring evidence for cooler climatic conditions between the fourteenth and nineteenth centuries. But the evidence was at best generalized. With North America and Greenland, Grove found firmer climatic ground, both in the Canadian and American west, also in Alaska. Here, again, she marshalled both historical and glaciological evidence, before moving on to Baffinland and Greenland. Chapter 9 surveyed glaciers in low latitudes and the Southern Hemisphere, East Africa, New Guinea, and South America, as well as New Zealand and the Sub-Antarctic islands. In New Zealand, she described work on the moraines of the southern Alps and documented the dramatic retreats since the Little Ice Age, at the time some of the best evidence for these centuries in the world.

From regional analyses, Grove moved onto a broader canvas, providing a summary of Holocene glaciation in all parts of the world, She placed particular emphasis on Friedrich Röthlisberger's studies of moraine sequences in both hemispheres, from which he showed that glacial extension and shrinkage occurred synchronously in both hemispheres. She also drew attention to Lonnie Thompson's then early work on the Quelccaya ice cap in the southern Andes, which showed that the Little Ice Age affected his area as clearly as glaciers in the Northern Hemisphere. Anyone reading Grove's summary cannot fail to be convinced that the Little Ice Age was a global phenomenon. This alone is worth the price of admission to the book. The global summary of the Holocene led to an extended essay on the causes of

the Little Ice Age, attributable, she said, to orbital forcing, as well as solar variability and volcanism, the latter perhaps affecting glacial fluctuations on a decadal scale.

The Little Ice Age was a global phenomenon, a time of constant short-term climatic changes. What then, asked Grove, were the consequences both physically and on human societies? The physical effects manifested themselves in sea-level oscillations, little documented when the book appeared, by changing snowlines and rates of erosion. Floods, rainfall shifts, and mass movements such as landslides and avalanches, as well as aeolian activity during cold, dry periods – all were significant factors at a local level. Biologically, pollen analysis and such topics as the northward spread of cod off Greenland in warm spells offered potential, but research, especially on animals, had hardly begun.

The impact of the Little Ice Age on human societies occupied nearly 30 pages of the last chapter, but covered well-trodden historical ground, especially that of Iceland and Greenland, where archives, journals, and some excavations provided richer documentation of the vicissitudes in cereal agriculture. Grove also discussed Scotland and northwestern Europe in a chapter that is remarkable for the limited data she had to draw upon. She also pointed out that Elsworth Huntington's environmental determinism of the 1920s, long discredited by historians, had never been adequately refuted. 'One wonders,' she wrote, 'How many historians appreciate the cumulative and progressive nature of scientific research' (p. 416). Would climatic conditions like those of the Little Ice Age return one day, she wondered. 'It might be wise not to assume that a return to Little Ice Age conditions is entirely out of the question', she concludes (p. 421).

The Little Ice Age is a magisterial accounting of what was known of these centuries a generation ago, and Grove herself would be the first to admit that the record was very incomplete. The book appeared at a time when climatologists were just becoming concerned over increased carbon dioxide concentrations in the atmosphere. Apprehension over anthropogenic warming, which, in Grove's view, was a factor in the end of the Little Ice Age, was still muted and confined to a small scientific community. In Grove's day, palaeoclimatology was an obscure, specialized subject, a community of scientists who mostly knew one another. Today, palaeoclimatology is big scientific business, with ever more participants in a massive international enterprise to decipher the mysteries of climate change, ancient, modern, and future. Computer modelling was virtually unknown when Grove's book appeared. Tree-ring sequences were rare, except in parts of northwest Europe and the American Southwest. Ice core research was in its infancy. At the same time, archaeologists and historians continued to discount the importance of long and shorter climatic change to the human societies of the past, fluctuations that one eminent historian described as 'one damn thing after another'. The revolution in climatology, it is nothing less, results both from the accelerating debates over global warming, and its emergence as a major political issue, but, certainly initially, from an increasing concern with the destructive potential of El Niño and La Niña events. In Grove's day, they were still considered somewhat local phenomena. Today, a new generation of oceanography and computer modelling has shown that unpredictable cycles of ENSOs (El Niño/Southern Oscillation) in the Pacific are, perhaps the single most important factor in global climate after the seasons. Fortunately, the new climatology has generated some interest in the impact of the Little Ice Age and shorter-term climate change on human societies. The historian Mike Davis has published (2004) a telling account of the effects of major ENSO events on nineteenth-century tropical farmers, estimating that between 20 and 30 million of them perished from famine-related circumstances during Victorian times. At the same time, we have learned a great deal

more about the Norse settlement and abandonment of Greenland as ice conditions shifted in the north, both from archaeologist Patrick McGovern's excavations on the Norse Western Settlement in Greenland and from Kirsten Seaver's comprehensive account (1996) of the rise and fall of the colony. New research on medieval European farmers, on sub-Saharan African farming communities in the Niger Basin, is bringing climatic change to the forefront. It is striking how Grove's synthesis of the consequences of the Little Ice Age is mainly confined to Europe, due largely to a dearth of tree-ring data, which now forms a huge grid of important proxy sequences, especially from Europe and North America. We know, for example, that Ancestral Pueblo people settled and abandoned Chaco Canyon, New Mexico, and its large pueblos as a consequence of slightly more rainfall, then an epochal drought. In the American far west, geographer Scott Stine has identified truly massive droughts during the Medieval Warm Period, which caused important changes in both coastal and desert societies. The same droughts can also be identified in Central and South America, where they contributed to the demise of the Maya civilization and the Tiwanaku state in highland Bolivia.

Both the Medieval Warm Period and the Little Ice Age had profound, if subtle consequences for ancient human societies. The effects could be immediate (drought and food shortages) or more indirect – social changes that took some generations to ripple through society. But, thanks to a growing number of fine-grained proxies, we now know enough about these two climatic events to realize that pervasive tropical droughts were as important as glacial advances and retreats. The Medieval Warm Period brought catastrophic droughts to much of the tropical world, while the cold winters of the Little Ice Age had important, but subtle, effects on European and Chinese societies.

The Little Ice Age is now outdated, for, as Grove herself pointed out, science is cumulative. But this important, and lasting synthesis, clearly written and closely argued, has laid the foundations for the much more fine-grained understanding of the Little Ice Age that we are acquiring today. This is one of those rare books that has triggered a new generation of research and helped take climatology in valuable new directions.

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